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Microhabitat of the Chainback Darter, *Percina nevisense* (Actinopterygii: Percidae), in the Upper Roanoke River in Salem, Virginia

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ABSTRACT

Microhabitat for Chainback Darter (*Percina nevisense*) was quantified from April 2016 to September 2017 using snorkeling observations and measurement of depth, current velocity, and substrate size. Mean depth of observation was 60.5 cm (SD = 16.7), mean current velocity at observation points was 0.17 meters per second (SD = 0.12), and mean substrate size was 8.1 cm (SD = 11.4). None of these variables differed statistically between adults and subadults. Depth, current velocity, and substrate size were also measured at 30 evenly spaced spots within the study site during October 2016. None of the means for measured parameters of occupied points were significantly different from available habitat. However, the variances of occupied and available habitat for October 2016 were statistically different for depth and velocity, but not substrate size. All three measured variables were not uniform among months. These analyses suggest that *P. nevisense* occupy specific habitats and those habitats change from month to month with a shift to deeper and faster water over finer substrates during March to May during the likely spawning season.

Keywords: current velocity, depth, snorkeling, substrate.

INTRODUCTION

While numerous characteristics of the biology of the Shield Darter, *Percina peltata* (Stauffer), have been described (New, 1966; Loos & Woolcott, 1969; Gray & Stauffer, 2001; Schmidt & Daniels, 2004), little is known of the biology of its sister species the Chainback Darter, *Percina nevisense* (Cope) (Actinopterygii: Percidae) as recognized by Goodin et al. (1998). Preliminary evaluation of morphological data (Raney & Suttkus, unpublished) suggests cryptic diversity may still exist within *P. nevisense* as currently recognized with specimens in the upper Roanoke River representing an undescribed taxon. Higher mean values for several meristic characters of Roanoke River specimens examined by Mayden & Page (1979) add supporting evidence to this hypothesized cryptic diversity. Further examination of this possible cryptic diversity is simultaneously made more difficult and important by the increased rarity of the species in the upper Roanoke River. Jenkins & Burkhead (1994) noted a decline in abundance in the upper Roanoke River throughout their surveys leading to an absence in their collections after 1976.

Despite the plethora of potential research projects investigating this charismatic species, recent efforts to collect specimens for study have not yielded enough individuals to provide meaningful data to help elucidate life history or systematics questions. In an effort to be more efficient with collection efforts and continue study of this species, we examined their microhabitat within a known population in the upper Roanoke River in Salem, Virginia.

MATERIALS AND METHODS

We made snorkeling observations of a known population of *P. nevisense* in the Roanoke River in Salem, Virginia (37° 16’ 57.46” N, 80° 04’ 01.75” W) each month from April 2016 to September 2017. We placed a numbered fluorescent green washer on the substrate at each point of first observation of *P. nevisense*, recorded the number of individuals, and estimated age class as adults (>80 mm SL), subadults (40-80 mm SL), or juveniles (<40 mm SL). Depth of water at each observation point was recorded with a meter stick as was the diameter of five representative rocks within 10 cm of the washer. We recorded current velocity approximately 5 cm above each washer with a FloWatch FW450 flowmeter in meters per second (m/s). Some months produced no observations and data due to high water levels, turbidity or absence of *P. nevisense.* To compare our data at observation points to available habitat, we collected the same data at 30 evenly spaced points within the study site in October 2016.

We used T-tests to test for differences in habitat between adults and subadults. Observation data from October 2016 were compared to available habitat data using T-tests and Bonett's tests to determine if occupied habitat differed from available habitat. We compared observation data from different months using a one-way Analysis of Variance to test for changes in habitat throughout the year. All statistical analyses were conducted in Mini-Tab 18 with alpha = 0.05.

RESULTS

We made a total of 266 observations of *P. nevisense* totaling 388 individuals including 364 adults, 23 subadults, and one juvenile. The mean number of individuals per observation was 1.46 (SD = 0.95) and the highest number of individuals at a single observation point was eight. For all observation points, mean depth was 60.5 cm (SD = 16.7), substrate diameter was 8.1 cm (SD = 11.4), and water velocity was 0.17 m/s (SD = 0.12). There were no differences between adults and subadults for any of the habitat variables (depth P = 0.219, substrate diameter P = 0.236, velocity P = 0.286). In comparisons of October 2016 observation data and available habitat data, there were no significant differences in mean water velocity (P = 0.109), depth (P = 0.905), or substrate size (P = 0.631). However, using Bonett's test for differences in variance, occupied habitat had a lower variance than available habitat for October 2016 for depth (P = 0.002) and velocity (P = 0.044), but variances were not different for substrate size (P = 0.142).

Occupied habitat variables were not uniform among months (depth P < 0.001, velocity P < 0.001, substrate size P = 0.001) (Figs. 1-3). Mean depth of observation points was greatest in May (83.2 cm, SD = 13.4) and lowest in July (48.9 cm, SD = 6.1). Mean current velocity was also greatest in May (0.275 m/s, SD = 0.116) and lowest in November (0.080 m/s, SD = 0.084). Substrate size was greatest in November (13.8 cm, SD = 12.55). The lowest mean substrate size was for March (5.5 cm, SD = 6.50).

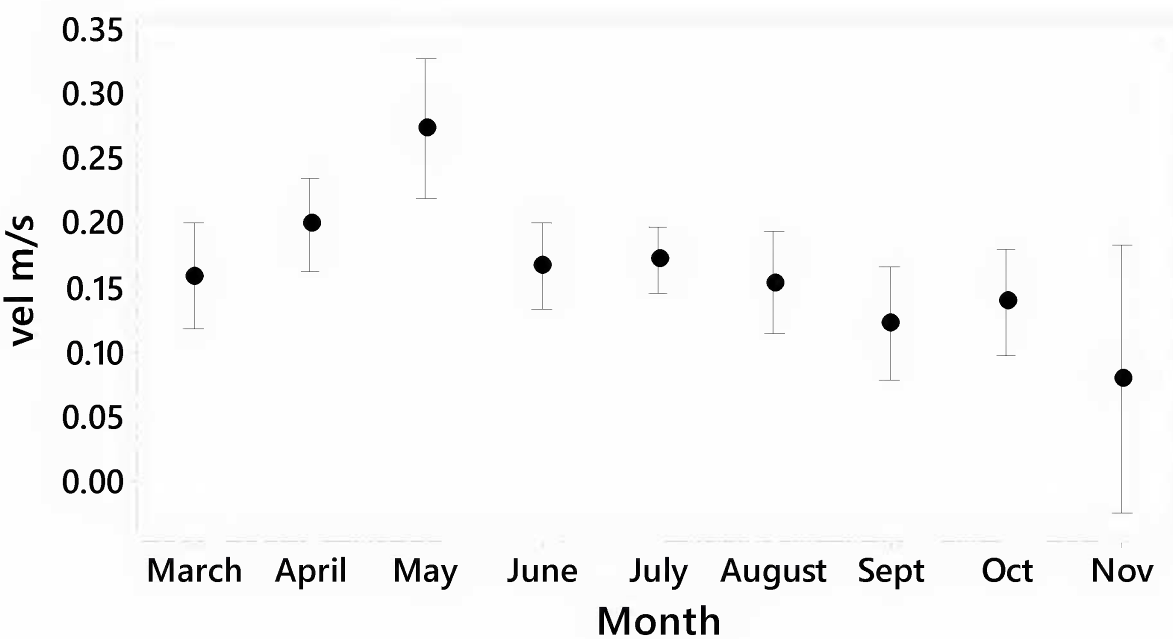

Fig. 1. Interval plot of current velocity (m/s) for monthly observation points of *Percina nevisense* in the upper Roanoke River, Virginia. Sample sizes for current velocity by month are: March (n = 15), April (n = 50), May (n = 20), June (n =41), July (n = 40), August (n = 40), October (n = 20), November (n = 5).

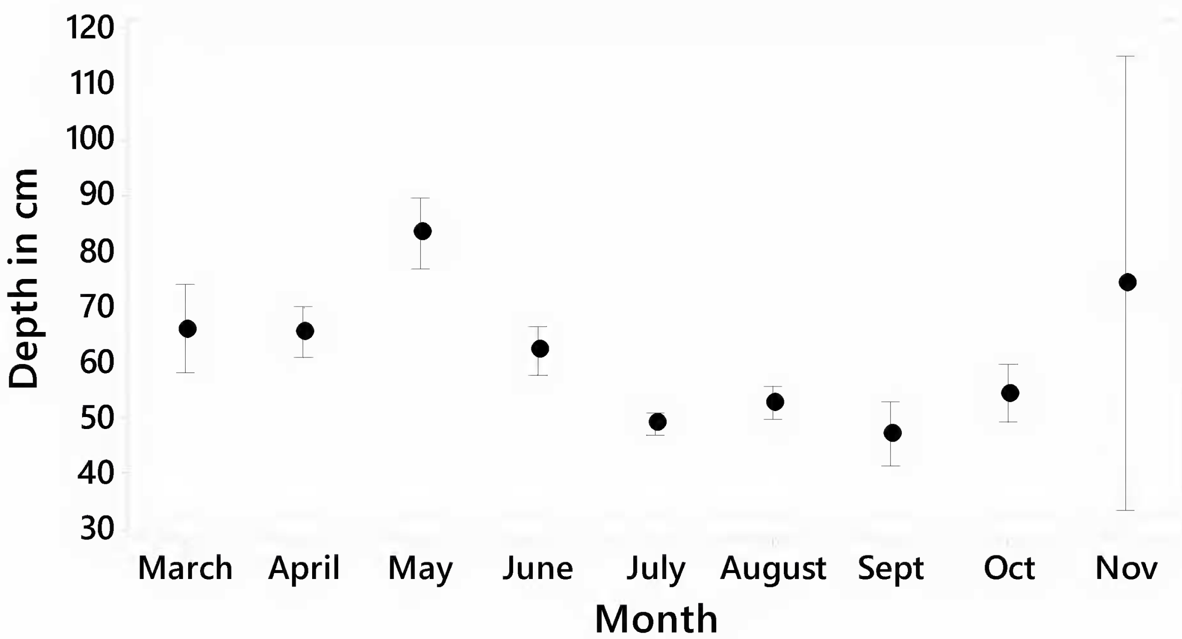

Fig. 2. Interval plot of depth (cm) for monthly observation points of *Percina nevisense* in the upper Roanoke River, Virginia. Sample sizes for depth by month are: March (n = 15), April (n = 50), May (n = 20), June (n = 41), July (n = 40), August (n = 40), October (n = 20), November (n = 5).

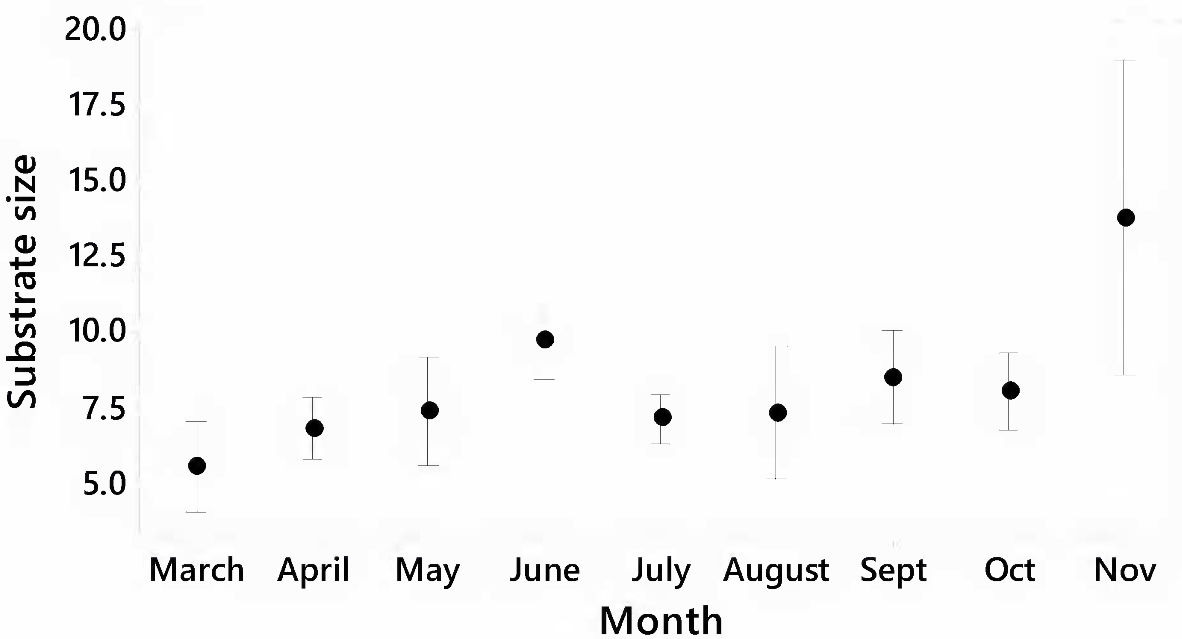

Fig. 3. Interval plot of substrate diameter (cm) for monthly observation points of *Percina nevisense* in the upper Roanoke River, Virginia. Sample sizes for substrate diameter by month are: March (n = 75), April (n = 250), May (n = 100), June (n = 405), July (n = 200), August (n = 200), October (n = 100), November (n = 25).

DISCUSSION

Our data suggest there is no difference between adults and subadults of *P. nevisense* in measured habitat variables. As only one juvenile specimen was observed during this study, little can be inferred about their specific habitat from our data. However, this dearth of data on juvenile *P. nevisense* habitat suggests there are likely differences from those of adults and subadults as has been documented for other species of darter. Rosenberger & Angermeier, (2003) found juvenile Roanoke Logperch, *Percina rex,* to inhabit slower, shallower waters than adults, and floodplains have been demonstrated to be important habitat for larval darters (Turner, et al. 1994). If juvenile *P. nevisense* were restricted largely to very shallow, slow moving backwaters, our observations would have likely missed them due to the difficulty snorkeling in those habitats.

While the mean values of current velocity, depth, and substrate size of our observation points were not statistically different than available habitat, differences in variance for two of the three measured variables suggest *P. nevisense* occupy more specific habitats than simply those available. The shallowest and deepest waters both appear to be largely avoided by *P. nevisense* because only five specimens were observed in water deeper than 100 cm, and only one specimen was observed in water shallower than 25 cm. The fastest and slowest currents also appear to be largely avoided by *P. nevisense*; only two specimens were observed in water flowing faster than 0.4 m/s, and only 41 specimens were observed in current that did not register on our flow meter, with all but 10 of these coming in summer and fall when instream flows were lower than in spring. *Percina nevisense* observed in October 2016 did not appear to have a preference for substrate size because occupied and available habitats were not statistically different. Habitat specificity for other darters within the upper Roanoke River is well documented with *Percina roanoka* occupying swifter current than *Etheostoma flabellare* in both natural and lab observations (Matthews et al., 1982; Matthews, 1985). Rosenberger & Angermeier (2003) also documented a preference for riffle and run habitats over gravel substrate for *Percina rex* in the upper Roanoke River. A greater understanding of the systematics and ecology of these darters has accompanied the documentation of their preferred microhabitat. Documentation of the apparent preference for water depth approximately 60 cm in moderate current may lead to more effective capture and observation of *P. nevisense* in future studies.

Differences in observation data from month to month also suggest the utilized habitat changes throughout the year with generally deeper, faster water over finer substrates occupied in spring, and shallower, slower water over larger substrates occupied in summer and fall (Figs. 1-3). While the biology of *P. nevisense* is largely unknown, *P. peltata* spawns in April and May in New York as water temperatures approach 10° C (New, 1966). Comparable water temperatures occur earlier in the spring in Virginia and ripe specimens were reported from late March to early June by Loos & Woolcott (1969) in the James River drainage. If *P. nevisense* has similarly timed spawning, our data suggest they are spawning in deeper, faster water, over finer substrates than they inhabit during summer and fall and is consistent with descriptions of *P. peltata* burying eggs in gravel to sandy substrates (New, 1966; Loos & Woolcott, 1969). Anecdotal descriptions by New (1966) suggest spawning habitat is not different from habitat occupied year round for *P. peltata*, but our data suggest *P. nevisense* spawn in at least slightly different habitat than is occupied through summer and fall.

As depth and current velocity at nearly every point in a stream are directly related to discharge, we evaluated the hypothesis that the precipitous decline in these values from May to June for observational data was due to changes in water levels in the Roanoke River between these months. However, our examination of daily streamflow data just upstream of our study site in the Roanoke River at Glenvar as recorded by the United States Geological Survey (https://waterdata.usgs.gov/va/nwis/current/?type=flow) led us to reject variation in streamflow as an explanation for differences in our data from May to June. Approximate flow during our May observations (17 and 19 May 2016) was 180 ft^3/s, and June observations (16 June 2016 and 12, 15, and 27 June 2017) occurred with flows ranging from 120 to 200 ft^3/s.

The findings of this study are intended to be a first step in learning more about *Percina nevisense*. A better understanding of microhabitat preference and seasonal changes in microhabitat will allow for more efficient observation and collection of specimens that can elucidate questions of ecology and systematics.

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